Quikscat Geophysical Model Function and High-Resolution Imaging of Tropical Cyclone Winds

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The feasibility of Quikscat for the measurements of tropical cyclone wind fields has been investigated with the data from the 1999 Atlantic hurricane season. To study the effects of rain, a semi-empirical approach has been undertaken. The QuikSCAT σ_0's with the collocated Special Sensor Microwave/Imager (SSM/I) rain rate have been analyzed for 58 Quikscat passes of 7 Atlantic hurricanes in 1999. The past difficulty of developing a GMF for high winds was due to the lack of in-situ measurements that can be paired with the satellite microwave data. We applied a technique using the wind fields from Holland's hurricane model for the development of a high wind model function for GeoSat altimeter. This technique is similar to the approach used to develop the NSCAT GMF, except with a more accurate surface wind model. The parameters of Holland's model include the location of the eye, central pressure, radius to the maximum wind, and the velocity of forward motion. The only parameter not available from the best track analysis from the National Hurricane Center (NHC) is the radius of maximum wind, but it can be estimated directly from the scatterometer data in terms of the radius of maximum σ_0 around the eye. The Holland's hurricane model is used to generate the surface wind fields at the scatterometer footprint. The Quikscat σ_0's are grouped into 4 m/s wind speed and 2 mm/h SSM/I rain rate bins. The average σ_0 in each bin is illustrated as a function of wind speed for a range of rain rate for the horizontal polarization. There appears a monotonic quasi-linear relationship with a smaller slope for a higher rain rate. The results imply the possibility of inferring the hurricane wind speed from the scatterometer σ_0's provided that the rain rate is given.

We modified the NSCAT2 GMF for the wind speed of above 20 m/s with the linear regression model. The modified GMF was used together with the collocated SSM/I rain rate to process the Quikscat data for the 1999 Hurricane Floyd. The estimated Quikscat wind field of Hurricane Floyd is illustrated. The results from the NSCAT2 GMF without rain correction significantly underestimate the strength of Hurricane Floyd, while the maximum wind speed of the improve QuikSCAT wind estimates was about 60 m/s, comparable to the one of 69.4 m/s reported by the National Hurricane Center on September 13, 1999.